Abstract of dissertation entitled

*An Evidenced-based Oral Care Guideline of Intubated Patients*

Submitted by

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Ventilator-associated pneumonia (VAP) is a kind of frequently hospital-acquired infection that increases morbidity and mortality in patients in intensive care units (ICU), which would in turn increase length of ICU stay, cost of hospital stay, and duration of mechanical intubation. Pneumonia appeared within 48 hours before onset of infection in people whose respiration is mechanically supported through endotracheal tube or tracheostomy is ventilator-associated pneumonia. Combating VAP is a major challenge in ICU as almost all ICU patients require mechanical intubation. Development of evidence-based methods to reduce the incidence and prevalence of VAP becomes an important issue in ICU.

The objectives of this dissertation are to conduct a thorough search of current evidence on the effectiveness of using different concentration, frequency of application, method of application and amount of chlorhexidine gluconate solution for oral care of adult intubated patients in reducing VAP incidence rate.
MEDLINE (OvidSP), CINAHL PLUS (EBSCOhost), PubMed and British Nursing Index were used to conduct electronic search using keywords related to VAP. A total of 99 studies were identified and seven were selected according to inclusion criteria. The quality of the seven selected studies was tested using The Scottish Intercollegiate Guidelines Network (2008) tools for randomized controlled trials, and the evidence level coding from Scottish Intercollegiate Guidelines Network was used in grading of recommendations. Six studies were rated as high quality, which oral care using chlorhexidine gluconate solution had shown statistically significant VAP incidence rate reduction or VAP-related parameters improvement.

Analysis on the implementation potential, transferability of findings, feasibility of implementation and cost-benefit ratio was conducted and the oral care guideline was beneficial to intubated patients. Implementation plan, communication plan and evaluation plan about oral care guideline application was formulated. The program designed to apply the new oral care guideline would last for one year, which includes communication with stakeholders, publication of the guideline, training of staff and a one month pilot test. The primary outcome was the decrease in VAP incidence rate and the process evaluation outcome were compliance and acceptability of the guideline, satisfaction and knowledge level of staff, and hospital cost reduction. The attainment of primary outcome and process evaluation outcome would be used to evaluate the effectiveness of the program.
An evidenced-based oral care guideline of intubated patients

by

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A dissertation submitted in partial fulfillment of the requirement for

the Degree of Master of Nursing

at The University of Hong Kong.

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Declaration

I declare that this dissertation represents my own work, except where due acknowledgement is given and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualifications.

Signature:_____________________

Chui On Lan
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Table of Contents

Abstract of dissertation ................................................................. 1
Cover page ..................................................................................... 3
Declaration .................................................................................... 4
Acknowledgments .......................................................................... 5
Table of Contents ........................................................................... 6

Chapter 1: Introduction .................................................................. 9
Background ................................................................................... 9
Affirming needs ........................................................................... 11
Significance .................................................................................. 14
Research Question ........................................................................ 15
Objectives .................................................................................... 15

Chapter 2: Review of Literatures and Critical Appraisal .................... 16
Identification of studies .................................................................. 16
Inclusion criteria ........................................................................... 16
Exclusion criteria .......................................................................... 16
Characteristics of selected literatures ............................................. 17
Quality assessment ........................................................................ 19
Result and summary ..................................................................... 22
Synthesis of data .......................................................................... 25
Recommendations .......................................................................... 29

Chapter 3: Implementation Potential of the Evidenced-based Practice Guideline .................... 30
Target setting, users, population and stakeholders ................................ 30
Transferability of findings .............................................................. 31
Innovation fit in proposed setting .................................................. 31
Comparison between local settings with research settings ............... 32
Philosophy of care ........................................................................ 32
Sufficient clients to benefit ............................................................. 32
Implementation and evaluation time ................................................. 32
Feasibility ..................................................................................... 33
Freedom to implement .................................................................. 33
Interfere with current function ....................................................... 33
Administration support .................................................................. 34
Consensus among staff .................................................................. 34
Friction among staff ...................................................................... 35
Skills available to implement intervention ...................................... 35
Facilities available to implement intervention.................................................. 35
Staff development needed.............................................................................. 36
Evaluation tools available................................................................................ 36
Cost and benefit ratio of the innovation......................................................... 37
Potential risks................................................................................................. 37
Potential benefits........................................................................................... 38
Risk of maintaining current practice............................................................ 39
Cost.................................................................................................................. 39

Chapter 4: Developing an evidence-based practice guideline.......................... 40
Evidence-based guideline title......................................................................... 40
Target users of the evidence-based guideline.................................................. 40
Objectives of the evidence-based oral care guideline....................................... 41
Target group..................................................................................................... 41
Major outcome.................................................................................................. 41
Recommendations.............................................................................................. 41

Chapter 5: Implementation Plan....................................................................... 49
Communication Plan......................................................................................... 49
Stakeholders...................................................................................................... 49
Communication process.................................................................................... 51
Communication instruments............................................................................. 51
Change process.................................................................................................. 52
Pilot study plan.................................................................................................. 53

Chapter 6: Evaluation plan................................................................................ 56
Intervention outcomes to be achieved............................................................. 56
Outcome measurement of short term outcome............................................... 56
Outcome measurement of long term outcome............................................... 57
Nature and number of clients involved............................................................ 58
Eligibility criteria............................................................................................... 58
Sample size calculation.................................................................................... 58
Recruitment of samples..................................................................................... 59
Data collection and analysis............................................................................. 59
Data collection.................................................................................................... 60
Data analysis....................................................................................................... 61
Criteria for effectiveness................................................................................... 62
Conclusion......................................................................................................... 63
Appendix 1: Searching history on 31st August, 2012
Appendix 2: Table of evidence
Appendix 3: Quality assessment using SIGN
Appendix 4: Grading of recommendations/ instructions scheme developed by the SIGN
Appendix 5: Level of evidence of selected literatures
Appendix 6: Philosophy of care
Appendix 7: Sufficient clients to benefit
Appendix 8: Implementation and evaluation
Appendix 9: Friction among staff
Appendix 10: Nurse training sessions
Appendix 11: Cost of implementing or not implementing the new oral care guideline
Appendix 12: Gantt Chart of implementation and evaluation of the oral care guideline
Appendix 13: Communication committee
Appendix 14: Communication instruments
Appendix 15: Change initiation
Appendix 16: Guidance of change
Appendix 17: Sustainment of change
Appendix 18: Evaluation Questionnaire for oral care training workshop
Appendix 19: Consent form
Appendix 20: Checklist for Oral care and Ventilator-associated pneumonia (VAP) in ICU
Appendix 21: Evaluation Questionnaire about perception of skills learned, knowledge level, and satisfaction level
Appendix 22: Eligibility criteria
Appendix 23: Recruitment of samples
References
Chapter 1: Introduction

Background:

According to American Thoracic Society (2005) and the Centers for Disease Control and Prevention (Horan, Andrus, & Dudeck, 2008), pneumonia appeared within 48 hours before onset of infection in people whose respiration is mechanically supported through endotracheal tube or tracheostomy is ventilator-associated pneumonia.

In the United States, ventilator-associated pneumonia developed in about 9 percent to 27 percent of all patients who received respiratory support by ventilator, in which with about 5 cases per 1000 ventilator days (Rello et al., 2002). In 2009, the National Healthcare Safety Network data report of the United States found that the mean ventilator-associated pneumonia incidence rate was 2 cases per 1000 ventilator days (Dudeck, Horan, & Peterson, 2011). In comparison, the incidence of ventilator-associated pneumonia in Hong Kong was 10.6 cases per 1000 ventilator days in 2004 to 2005 (Chawla, 2008), and the Centre of Health Protection from the Department of Health of Hong Kong reported that there were 4.4 to 15.7 cases per 1000 ventilator days in 2010 (Centre for Health Protection of Department of Health of Hong Kong, 2010). The incidence of ventilated-associated pneumonia in Hong Kong does not show any advantageous position when compared to that of the United States.
There are four mechanisms that govern micro-organisms to gain access to the sterile lower respiratory tract to cause pneumonia, which are the aspiration of secretions, extension of infection, inhalation of infected air and haematogenous carriage from remote area to local area (Alcon, Fabregas, & Torres, 2003). Safdar, Crnich, and Maki (2005) pointed out that the most common way of getting ventilator-associated pneumonia in mechanically ventilated patients was the aspiration of oropharyngeal secretion into lungs. It was because the presence of the endotracheal tube made it difficult to inspect and clean the oral cavity of intubated patients (Blot, Vandijck, & Labeau, 2008). Therefore, a possible strategy to reduce ventilator-associated pneumonia would be achieved by lowering the number of microorganisms present in the oral cavity (Fourrier et al., 2000; and Grap, Munro, Elswick, Sessler, & Ward, 2004). Reducing microbes in the oral cavity would be a reasonable prevention method to reduce the chance of aspiration of microorganisms from oropharyngeal secretion into the lungs causing ventilator-associated pneumonia.
Affirming needs:

Safdar, Dezfulian, Collard, and Saint (2005) pointed out that ventilated-associated pneumonia was a kind of frequently hospital-acquired infection that threatened 10 percent to 30 percent of patients using mechanical ventilation. It also accounted for 25 percent of all infections and 50 percent of all antibiotic prescriptions in mechanically ventilated patients (Ashraf & Ostrosky-Zeichner, 2012).

Moreover, ventilated-associated pneumonia significantly increased morbidity, mortality, length of stay in hospital in intubated patients, which could directly increase the health care expenses (Safdar et al., 2005). The attributable mortality of ventilated-associated pneumonia was about 8 percent to 15 percent (Muscedere, Day, & Heyland, 2010; Nguile-Makao, Zahar, & Français, 2010; Schumacher, Wangler, Wolkewitz, & Beyersmann, 2007). Warren, Shukla, and Olsen (2003) found that the length of stay of intubated patients having ventilator-associated pneumonia was 38 days, while it was only 13 days in intubated patients not having ventilator-associated pneumonia (p<0.001). In addition, Warren et al. (2003) found that the cost used in intubated patients having ventilator-associated pneumonia were $70568, while that in intubated patients not having ventilator-associated pneumonia were only $21620 (p<0.001). When compared with intubated patients who did not have ventilator-associated pneumonia, the length of stay and the cost used in intubated patients who had ventilator-associated pneumonia were nearly tripled.
Every ventilated patient received oral care everyday, though the types, concentration, frequency and methods of solution to be used on oral care was inconsistent in Hong Kong. The treatment used to tackle ventilator-associated pneumonia was mainly the use of antibiotics. However, complete courses of antibiotics were very expensive and the most apparent complication was antibiotic resistance. As pointed out before, the most important mechanism in ventilator-associated pneumonia development was the aspiration of oropharyngeal secretions to the lung (Safdar et al., 2005). Fourrier et al. (2000) supported that reduction in oral microorganisms had a potential prevention of ventilator-associated pneumonia. Chlorhexidine was recommended in UK to control ventilator-associated pneumonia as part of the oral care to reduce oral microorganisms of patients using mechanical ventilation (National Institute for Health and Clinical Excellence, 2008). Moreover, the Guidelines for Preventing Healthcare-associated Pneumonia by Centers for Disease Control and Prevention (CDC) recommended patients undergo cardiac surgery to use chlorhexidine to rinse mouth in perioperative period (Tablan, Anderson, Besser, Bridges, & Hajjeh, 2004).

Newman (1998) supported that chlorhexidine was antibacterial in nature with a broad spectrum which was largely used on daily basis to control oral plaque and to treat gingivitis. Chlorhexidine was proven to be effective in decreasing respiratory tract infection rate of cardiac patient only, who use chlorhexidine in perioperative period
(Houston et al., 2002). In Hong Kong, Centre for Health Protection of Department of Health of Hong Kong (2010) had a recommendation about consideration of using chlorhexidine for oral care of ventilated patients to reduce ventilator associated pneumonia. However, it is difficult for health care professionals to follow the recommendation as it did not provide any recommended frequency or concentration of chlorhexidine that should be used. Moreover, it is not compulsory for health care professionals to follow a recommendation that lacks evidence to support its use. Therefore, in order to improve patients’ outcome and to reduce health care expenses on ventilator associated pneumonia, an evidence-based oral care guideline in hospital for ventilated patients is needed in Hong Kong.
**Significance:**

The formulation of evidence-based oral care guideline for ventilated patients would have some potential benefits to patients, doctors, nurses and institutions.

To patients, oral care guideline would reduce ventilator-associated pneumonia related morbidity, mortality and length of stay. Beraldo and deAndrade (2008) further supported that oral care of intubated patients was a rather safe and tolerable procedure. Performing oral care would directly increase the quality of life of patients.

To nurses, it would increase the participation level of evidence-based practice and would standardize oral care regimen in different hospital departments.

To doctors, it would let them to focus more on major health problems of patients other than VAP, this offers better quality of care to patients.

To the institutions, it would help to reduce cost as less expensive chlorhexidine gluconate solution would replace those expensive antibiotics to prevent ventilator-associated pneumonia, and the duration of hospitalization of intubated patients would be reduced.
**Research question:**

In adult aged 18 or above patients who are mechanically intubated, does oral care using chlorhexidine gluconate reduce incidence rate of ventilator-associated pneumonia?

**Objectives:**

The aims of this dissertation is to develop an evidence-based oral care guideline based on the best available evidence in order to reduce incidence rate of ventilator-associated pneumonia in adult patients who are receiving mechanical intubation. The objectives of this dissertation are:

1. to conduct a thorough research of current evidence on the effectiveness of using chlorhexidine gluconate to care mouth in adult patients who are receiving mechanical intubation;
2. to critically appraise the quality of the selected literatures;
3. to synthesize data from the selected literatures to develop evidence-based oral care guideline;
4. to assess the implementation potential of the new oral care guideline;
5. to develop plans to implement the new oral care guideline; and
6. to evaluate the outcomes of the new oral care guideline.
Chapter 2: Review of Literatures and Critical Appraisal:

Identification of studies:

There were four electronic databases employed to search relevant journal articles, which were MEDLINE (OvidSP), CINAHL PLUS (EBSCOhost), Pubmed and British Nursing Index. All were searched on 31st August of 2012. The searching history of each database was shown in Appendix 1. The keywords used in searching including “oral care or oral decontamination or oral hygiene or oral health”; AND “chlorhexidine”; AND “ventilator associated pneumonia or pneumonia”.

Inclusion criteria:

The inclusion criteria were adult aged 18 or above and patients should be mechanically intubated. Use of chlorhexidine gluconate should be mentioned in oral care. The publication year was limited to 2003 to present and only randomized controlled trials were accepted.

Exclusion criteria:

Reviews, news, editorials, personal opinions were excluded from searching. Pediatric population was not accepted. Studies that were using qualitative research design, quasi-experimental design or non-experimental were not included.

Two studies in British Nursing Index, 47 studies in PubMed, 8 studies in
CINAHL PLUS and 42 studies in MEDLINE were yielded using the above keywords, limits, inclusion criteria and exclusion criteria. All the articles were compared and the duplicated were declined. They were then screened by using the abstracts and full texts. The bibliography of each relevant paper was also consulted to search for potential useful studies. Finally, 7 articles were selected in this dissertation.

**Characteristics of selected literatures**

Seven studies were selected from the mentioned databases and details of studies were presented in the table of evidence in Appendix 2. All studies were randomized controlled trials. Four of them were conducted in the United States while one in Europe, one in Turkey and one in Thailand. None of them was conducted in Hong Kong. All of them were carried out in intensive care units, only that of Tantipong, Morkchareonpong, Jaiyindee, and Thamlikitkul (2008) also included general medical wards.

Within these 7 studies, only Koeman, van der Ven, and Hak (2006) made use of multicenter setting to conduct the research, while others were focused on one site to collect data. The sample size ranged from 34 to 257, and the mean age ranged from 42.4 to 62.1 years. Four studies used placebo, such as using normal saline or distilled water, as comparison, while the other three studies made use of usual care as comparison.
Both the experimental group and control group in four studies used placebo as comparison have received other standard oral care such as brushing, suctioning and positioning; while the groups in the other three studies did not. Six of the seven studies used swabbing as the method of chlorhexidine gluconate application, while only one of them (Tantipong et al., 2008) was using rubbing.

There were three different concentrations of chlorhexidine gluconate used, four of them used 0.12 %, one of them used 0.2%, and two of them used 2%. The frequencies of chlorhexidine gluconate application were once per day, twice per day, or four times per day; and the amount of chlorhexidine used ranged from 2 ml, 5ml, 15ml, 20 ml and 30 ml.

Five studies used Clinical Pulmonary Infection Score to diagnose ventilator-associated pneumonia, with the other two studies made use of objective criteria such as chest x-ray, body temperature, culture of tracheal aspirate and culture of pleural fluid, to diagnose ventilator-associated pneumonia. All the study results of Koeman et al. (2006) and Ozçaka et al. (2012) were statistically significant, while that of Grap et al. (2004) were totally not statistically significant.
Quality assessment

The Scottish Intercollegiate Guidelines Network (2008) tools for randomized controlled trials (details in Appendix 3) was used to critique the quality of the selected seven studies and the evidence level coding from Scottish Intercollegiate Guidelines Network (details in Appendix 4) was used in grading of recommendations or instructions.

All of the studies were comparing if the use of chlorhexidine gluconate in oral care of mechanically intubated adult patients would reduce the incidence of ventilator-associate pneumonia or other parameters related to ventilator-associated pneumonia. To be more reliable and comparable, using randomized controlled trials was appropriate for this topic and therefore all of the selected literatures were randomized controlled trials. Randomization was observed in all of the selected studies.

Five studies (Grap et al., 2004; Grap et al., 2011; Koeman et al., 2006; Ozçaka et al., 2012; Scannapieco, Yu, & Raghavendran, 2009) had adequately used concealment method to ensure group allocation was not known by researchers, such as using computerized randomization allocation system in the study of Koeman et al. (2006) and web-based subject enrollment system in the study of Scannapieco et al. (2009); while Tantipong et al. (2008) and Munro, Grap, Jones, McClish, and Sessler (2009) did not have clear description of concealment.
Four studies (Grap et al., 2004; Koeman et al., 2006; Ozçağa et al., 2012; Scannapieco et al., 2009) used double blinding to keep people unaware of treatment group throughout the process, while the other three were using single blinding method.

Five studies (Grap et al., 2004; Grap et al., 2011; Ozçağa et al., 2012; Scannapieco et al., 2009; Tantipong et al., 2008) had used level of significance to show if there were any initial differences between intervention and control group. Four of them with p>0.05 showed no initial difference, while Grap et al. (2011) showed more male (p<0.02) and Clinical Pulmonary Infection Score (CPIS) (Pugin et al., 1991) (p=0.023) was higher in experimental group, with p>0.05 in all the other characteristics. No level of significance for initial differences was given in Munro et al. (2009) and Koeman et al. (2006), only numerical values on different initial characteristics could be seen in these two studies.

All the studies could measure the outcome in a reliable way, except the tool used to measure growth of organisms by Grap et al. (2004) was invalid and unreliable because the psychometric properties was not test on this tool.

The drop out rate of four of the studies (Grap et al., 2004; Grap et al., 2011; Munro et al., 2009; Tantipong et al., 2008) were relatively high as researchers could not control the time of intubation or extubation of patients, which was an important limitation of conducting research about mechanically intubated patients.
Three studies (Koeman et al., 2006; Scannapieco et al., 2009; Tantipong et al., 2008) had performed intention to treat basis to reduce the attrition bias and to conserve data for final analysis, while others did not.

Within the seven selected studies, only Koeman et al. (2006) employed multicenter setting to collect data at different sites, this could increase generalizability of the research findings.

The overall evidence level coding was scored according to Scottish Intercollegiate Guidelines Network (Appendix 4). Studies conducted by Koeman et al. (2006), Scannapieco et al. (2009) and Ozçaka et al. (2012) were ranked as 1++, and that of Tantibong et al. (2008), Munro et al. (2009) and Grap et al. (2011) were ranked 1+, and Grap et al. (2004) was ranked as 1-. The ranking was based on the quality assessment results. For more details about the grading of level of evidence, please see Appendix 4.
Result and summary

Comparing the chlorhexidine group with control group, all the seven studies showed a reduced rate of incidence of ventilator-associated pneumonia or an improvement in its related outcomes. The study by Tantipong et al. (2008) had 6.5% ventilator-associated pneumonia reduction (RR 0.43, 95%CI; 0.16,1.17, p=0.08), the study by Grap et al. (2011) had 22.3% ventilator-associated pneumonia reduction, the study by Koeman et al. (2006) had 65% ventilator-associated pneumonia reduction daily (HR=0.352; 95% CI, 0.160, 0.791; p=0.012), and the study by Ozçaka et al. (2012) had 27.4% reduction in the ventilator-associated pneumonia rate (p=0.03, OR =8.91, 95% CI, 1.09, 8.91). Munro et al. (2009) showed statistically significant reduction in CPIS (p=0.02) on day 3 of patients who did not have pneumonia at baseline; and there was 28% reduction (p=0.006) in the incidence rate of ventilator-associated pneumonia on day 3 of patients who did not have pneumonia at baseline. These studies showed similar direction of result.

On the other hand, Grap et al. (2004) did not get statistically significant result, but the results were still on the same direction like others, so that there were more “no growth” cultures and less increase in CPIS in experimental group than that in control group. Although the number of Staphylococcus aureus had significantly reduced on day 2 (p=0.0065) and on day 4 (p=0.0201) of the study of Scannapieco et al. (2009), the incidence rate of ventilator-associated pneumonia did not have statistically
significant (p=0.1459) result even it was decreased by 40%. 

All of the studies used mechanical ventilation and aged 18 or above as the inclusion criteria, while the exclusion criteria varied. Some excluded edentulous patients while some did not accept patients with clinical diagnosis of pneumonia at the time of intubation, chlorhexidine gluconate allergy, having immune-compromised status, recent intubation or having oral mucositis. 

Other than using incidence of ventilator-associated pneumonia, some studies had more than one primary outcomes which were all closely related to ventilator-associated pneumonia. CPIS could reflect ventilator-associated pneumonia rate directly and it was an important score to diagnose ventilator-associated pneumonia. Grap et al. (2011) used CPIS at 48 hour and at 72 hours to compare with CPIS at admission; and Munro et al. (2009) used CPIS to make comparison with those without pneumonia at baseline. Similarly, Grap et al. (2004) used oral cultures with “no growth” at 48 hour as primary outcome, Tantipong et al. (2008) used the amount of oropharyngeal colonization with gram-negative bacilli as primary outcome, and Scannapieco et al. (2009) used number of Staphylococcus aureus on day 2 and day 4 as primary outcome because presence of bacteria was a direct cause of ventilator-associated pneumonia. The use of the mean number of cases of ventilator-associated pneumonia per 1000 ventilator-days in the study of Tantipong et al. (2008) was a relative rate of ventilator-associated pneumonia, demonstrating the
incidence rate of ventilator-associated pneumonia. In the study of Ozçaka et al. (2012), the researchers employed mortality rate as the other primary outcome because it was an indirect adverse effect of having ventilator-associated pneumonia.

All studies contained different secondary outcomes such as length of stay, length of intubation, percentage of endotracheal colonization, percentage of irritation of oral mucosa, and overall mortality rate, which should not be the focus in the establishment of the oral care guideline, but they were treated as supplementary information sources when formulating of the oral care guideline.
Synthesis of data:

After performing the critique and summary of the studies, it was found that the use of chlorhexidine gluconate for oral care in adult mechanically ventilated patient could reduce ventilator-associated pneumonia in different aspects. Because of the inconsistency of oral care was being practiced in different hospitals in Hong Kong, recommendations about the method, frequency, concentration and amount of chlorhexidine could be made by further analysis of the selected studies. In the critical appraisal, the evidence level coding from The Scottish Intercollegiate Guidelines Network (2008) yielded three 1++ high quality randomized controlled trials with very low risk of bias, three 1+ well conducted randomized controlled trial with low risk of bias, and one randomized controlled trial with high risk of bias. It is because there are already three high quality studies that are of very low risk of bias, for the sake of patients’ best interest and safety, the following recommendations would focus mainly on the results of these three high quality studies (Koeman et al., 2006; Ozçaka et al., 2012; Scannapieco et al., 2009).
**Method of chlorhexidine application:**

Adverse outcome of chlorhexidine application method was an important parameter to be considered. The only adverse outcome that could be found in the three studies was tongue edema in the study of Koeman et al. (2006), but the affected population was too small to be noticed (1 case in 257 cases). In the three ranked 1++ studies, all of them used swabbing as their method of chlorhexidine application with minimal adverse outcomes resulted. Therefore, swabbing would be chosen as the method of chlorhexidine application in the oral care recommendation.

**Frequency of chlorhexidine application:**

Based on the three high quality studies, Koeman et al. (2006) and Ozcaka et al. (2012) used four times chlorhexidine application per day, while that of Scannapieco et al. (2009) used one time per day or two times per day.

The primary outcome of Koeman et al. (2006) was the daily risk of ventilator-associated pneumonia and it had decreased 65% in treatment group (p=0.012), while that of Ozçaka et al. (2012) was the incidence of ventilator-associated pneumonia and it had decreased by 27.4% in treatment group (p=0.03, OR =8.91, 95% CI, 1.09, 8.91). The fact is that the aim of the oral care guideline was to reduce the incidence of ventilator-associated pneumonia, which could totally fit into the primary outcome of the studies of Koeman et al. (2006) and Ozcaka et al. (2012). In addition, both of the primary study outcomes of
Koeman et al. (2006) and Ozçaka et al. (2012) could reach statistical significant results. However, the study conducted by Scannapieco et al. (2009) placed the most important outcome of the oral care guideline about ventilator-associated pneumonia into its secondary outcome only. Moreover, its primary outcome showed the same level of significance level on the number of oral Staphylococus aureus on day 2 \( p=0.0065 \) and on day 4 \( p=0.0201 \) between one time per day or two times per day, no conclusion could be drawn on whether one time or two times per day was more effective than one another. Therefore, four times per day was a priority choice for application of chlorhexidine for oral care per day instead of one time per day or two times per day.

**Concentration and amount of chlorhexidine solution:**

The chlorhexidine concentration used in these three high quality studies were 2\% (Koeman et al., 2006), 0.12\% (Scannapieco et al., 2009) and 0.2\% (Ozçaka et al., 2012). 0.12\% chlorhexidine would not be chosen because the study using 0.12\% chlorhexidine (Scannapieco et al., 2009) only placed ventilator-associated pneumonia incidence rate in the secondary outcome, and it could not show statistically significant results (OR= 0.54, 95\% CI, 0.23 to 1.52, \( p=0.1459 \)).

In the study using 0.2\% chlorhexidine (Ozçaka et al., 2012), it did not evaluate the effect of 0.2\% chlorhexidine on the colonization of oral micro-organisms, and the study was carried out in one respiratory intensive care unit only, this could limit generalizability of
the research result. Therefore, 0.2% chlorhexidine would not be chosen.

In the study using 2% chlorhexidine conducted by Koeman et al. (2006), the primary outcome was daily risk of ventilator-associated pneumonia and it showed statistically significant 65% reduction in ventilator-associated pneumonia incidence rate in treatment group (p=0.012), and it did have further evaluation about oral organisms colonization in its secondary outcome that could indirectly reflect the action of chlorhexidine gluconate on micro-organisms, which was not found in the study of Ozcaka et al. (2012). Moreover, the relative risk of oral colonization with gram-positive micro-organisms and gram-negative micro-organisms was 0.695 (95% CI; 0.606, 0.796, P<0.001) and 0.826 (95% CI; 0.719, 0.950; P=0.007) and the results were statistically significant, it was effective on both gram-positive and gram-negative organisms in the study by Koeman et al. (2006).

The study of Ozçaka et al. (2012) conducted the study only in a single respiratory intensive care unit, while that of Scannapieco et al. (2009) in a single trauma intensive care unit, this could greatly limit the generalizability of the research findings. However, Koeman et al. (2006) made use of multicenter setting to collect data, which could increase the generalizability of the research findings. Moreover, the study of Koeman et al. (2006) had the largest sample size within the three studies, and it was much higher than that in the study using 0.2% chlorhexidine conducted by Ozçaka et al. (2012). Therefore, 0.2% and 0.12% would not be chosen, 2% is chosen. The concentration and
amount of chlorhexidine have a direct effect on each other, they should not be considered separately. Therefore, 20 ml of 2% chlorhexidine would be chosen.

**Recommendations:**

In combining all the above recommendations, it was proposed that the new oral care guideline would be 20 ml of 2% chlorhexidine and would be applied four times per day by swabbing. The recommendation based on three ranked 1++, three 1+ and one 1- literatures could be ranked as Grade A in grading of recommendations of The Scottish Intercollegiate Guidelines Network (2008).
Chapter 3: Implementation Potential of the Evidenced-based Practice Guideline:

Different aspects of oral care in mechanically intubated patients had been evaluated in the previous section. With the establishment of evidence-based guideline, Polit and Beck (2008) supported that the target setting and population, the implementation potential of the proposed innovation, and the cost-benefit-ratio in local setting should be addressed before use.

Target setting, users, population and stakeholders:

The target setting was intensive care unit of a local acute regional hospital which provided 1841 beds serving the central part of Kowloon. The intensive care unit was divided into two subunits with 23 beds supporting seriously ill adult patients. The target population was patients aged 18 or above who were mechanically intubated in intensive care unit of the target hospital. The target user of this oral care guideline was mainly nurses, namely for all intensive care units nurses who needed to take care of mechanically intubated patients. The stakeholders of this oral care guideline were the nurses and doctors of intensive care units of the target hospital.
Transferability of findings:

According to Polit and Beck (2008), comparison between research and real settings should be made in order to assess the transferability of research findings. For a deeper understanding, the philosophy of care of the proposed hospital and the number of clients to be benefited was examined before the implementation of the oral care guideline.

Innovation fit in proposed setting:

The new oral care innovation fits well in the local intensive care unit. Given the identical target population of research setting and proposed setting, the considerable reduction of ventilator-associated pneumonia rate and the number of patients gaining benefits from the innovation was favorable. It was noted that all previous studies were conducted in intensive care units, nurses shared similar oral care theory and oral care practice as those in Hong Kong, although nurses of the proposed setting and the research could have different cultures, race, social and economic background.
Comparison between local settings with research settings

Nurse to patient ratio in intensive care units of proposed setting and the other research studies reviewed was similar, with one nurse serving one patient. The research population and the proposed setting population was also comparable, with patients aged 18 or above and had needs to be mechanically intubated in intensive care units. The major outcome of this oral care guideline, which was the reduction in incidence of ventilator-associated pneumonia, was also comparable with the selected literatures.

Philosophy of care: (details in Appendix 6)

Sufficient clients to benefit: (details in Appendix 7)

Implementation and evaluation time: (details in Appendix 8)
Feasibility:

Feasibility of the implementation of the innovation was a practical consideration. This included the readiness of nurses and organization to change, effect of the innovation to staff, availability of organizational or other supports, skills and facilities availability, and presence of possible evaluation tools.

Freedom to implement

The innovation was evidence-based that aimed to improve patients’ outcome. Nurses in intensive care units would be allowed to implement this new oral care guideline in view of improving quality of oral care. At the same time, nurses were free to terminate the guideline in case of any adverse outcome arisen.

Interfere with current function

Implementation of the new oral care guideline should not interfere with the current function of the target hospital setting. Oral care was routinely done to every patient in intensive care unit, nurses should have fruitful experience on oral care of intubated patients. However, the frequency of oral care would be standardized, and the routine time for oral care would have minor changes. Nurses need to perform more frequent oral care to patients but this should not add too much workload to nurses as the entire oral care process would only last for a few minutes.
**Administration support**

The target hospital was a large regional hospital with a research team which aimed at supporting research and research sharing. The head of intensive care unit strived for quality care of patients and was always welcome translating research into practice. Moreover, the Hospital Authority (2009) promoted and encouraged the use of evidence-based guidelines or standards to improve quality of care and reach better patient outcome. The organizational climate was most suitable for this oral care guideline to implement.

**Consensus among staff**

There was a consensus among nurses and administrators that ventilator-associated pneumonia was the most frequently hospital-acquired infection, which increased length of stay (Rello et al., 2002) and cost of hospital stay (Warren et al., 2003). Oral hygiene was a key factor in prevention of ventilator-associated pneumonia (McFetridge, 2009). It was believed that nurses play an important role in preventing ventilator-associated pneumonia, especially by oral care. Moreover, Jones, Newton, and Bower (2004) pointed out that oral care was the most fundamental nursing care that could not be overlooked. Every nurse would welcome this evidence-based oral care guideline in view of improving patients’ outcome and similar workload if compared with current oral care practice.
Friction among staff: (details in Appendix 9)

Skills available to implement intervention

All nurses in intensive care unit were experienced in providing oral care. However, there was a need to learn about Mini-BAL which was a new method to collect specimen from the lung to diagnose ventilator-associated pneumonia. Training sessions would be offered to all nurses with six of them would be trained as trainer to supervise staff during the implementation period.

Facilities available to implement intervention

As mentioned before, the new oral care guideline was similar to what nurses were practicing every day, with most oral care facilities were readily available, with no new equipment was required for the implementation of new guideline. However, the frequency of application would be increased and concentration of chlorhexidine would be changed, there was a need to order enough 2% chlorhexidine solution from hospital pharmacy.
Staff development needed

Although every nurse in intensive care unit should have possessed oral care skills for intubated patients, training was needed to assist nurses to revise the whole oral care procedures using chlorhexidine by swabbing, to set up a new routine time for oral care, and to learn a new specimen collecting technique for diagnosis of ventilator-associated pneumonia. In order to standardize every oral care step and samples collecting procedure, a one hour training session (details in Appendix 10) would be offered to all nurses in the intensive care unit. An assessment would be conducted at the end of each training session to ensure unity and accuracy of the entire process.

Evaluation tools available

The aim of the new oral care guideline was to reduce ventilator-associated pneumonia, therefore the incidence of ventilator-associated pneumonia would be recorded as the outcome indicator, and be compared with the record of the past 12 months. Moreover, ongoing and open discussions were always welcome throughout the implementation period. Evaluation using questionnaires and focus groups would be conducted biweekly as process evaluation, asking about the acceptance, difficulties and comments when implementing the new oral care guideline.
Cost and benefit ratio of the innovation:

Polit and Beck (2008) pointed out the cost and benefit of implementing or not implementing an innovation should have thorough analysis before use. Cost and benefit ratio was particularly important in achieving maximum benefits using limited resources with minimal risks. The expected benefits, costs and potential risks of this oral care guideline would be assessed before the implementation, which was the key to see if the innovation would be used in long run.

Potential risks

Performing oral care was a daily necessity to intubated patients which was done routinely for every patient in intensive care unit. Resistance to chlorhexidine in long term use would be a potential concern. Research supported that chlorhexidine did not have any microbial resistance or any side effects (Scannapieco et al., 2009; Tantipong et al., 2008). Chlorhexidine had long been used as daily oral rinse to prevent gingivitis and oral plaque without any adverse complications (Iacono, Aldredge, Lucks, & Schwartzstein, 1998; Newman, 1998).
Potential benefits

1) Client benefits

The incidence rate of ventilator-associated pneumonia would be decreased and the oral hygiene can be maintained among intubated patients. Health care professionals would focus more on treating the main disease of intubated patients instead of distracting the treatments because of ventilator-associated pneumonia. These changes would in turn decrease morbidity of patients, reduce cost and length of stay in intensive care unit.

2) Non-material benefits

The reduction in incidence of ventilator-associated pneumonia would increase nurses’ sense of preventing the ventilator-associated pneumonia. Job satisfaction would increase as nurses would believe that the use of evidence-based innovation could play an important role in improving patients’ outcomes and reduce the workload of nurses. In view of higher acceptance of evidence-based guidelines, the organization and institute would be further benefited from saving cost and improving patients’ outcomes by using other evidence-based guidelines in other aspects.
Risk of maintaining current practice

The risk of acquiring ventilator-associated pneumonia would be higher. Patients would have a longer length of stay, with a higher morbidity rate and add cost on treating ventilator-associated pneumonia. The varying oral care frequency in current practice would also affect the quality of life of patients.

Cost: (details in Appendix 11)
Chapter 4: Developing an evidence-based practice guideline

After searching of literatures from different research databases, critical appraisal of the seven selected studies and the synthesis of data of these studies, an oral care guideline had been developed from these studies. The Scottish Intercollegiate Guidelines Network (2008) tool was used in grading of recommendations (details in Appendix 4). The level of evidence of the seven selected studies was shown in Appendix 5.

Evidence-based guideline title:

“An Evidenced-based Oral Care Guideline of Intubated Patients”.

Target users of the evidence-based guideline:

This guideline was developed to be used by nurses, namely for all nurses who need to take care of mechanically intubated patients.
Objectives of the evidence-based oral care guideline:

This guideline aimed to prevent ventilator-associated pneumonia among mechanically intubated patients based on the best available evidence. The objectives of this guideline were

i) to provide hands on evidence-based oral care guideline to standardize the oral care procedure of mechanically intubated patients; and

ii) to provide optimal oral care for mechanically intubated patients to prevent ventilator-associated pneumonia.

Target group:

The target population of this guideline was patients aged 18 or above and who were mechanically intubated in intensive care unit.

Major outcome:

The major outcome of this oral care guideline was the reduction of incidence of ventilator-associated pneumonia.
Recommendations:

The recommendations were originated from the seven selected studies.

Different aspects of recommendations e the need of oral care, type of cleansing solution, frequency of oral care, amount of solution used, and method of oral care.

Recommendation 1) Need of oral care

Oral care should be used in intubated patients. [A]

Evidence:

Ventilator-associated pneumonia could be prevented by decreasing the number of pathogens in oropharyngeal secretions (Fourrier et al., 2000; Koeman et al., 2006; Ozçaka et al., 2012; Scannapieco et al., 2009). (1++)

Rationale:

Colonization of oropharyngeal secretions aspirates to lung is the major ventilator-associated pneumonia mechanism (Safdar et al., 2005). (1+)

Antiseptic solutions should be used in oral care to reduce pathogens in oropharyngeal colonization (Safdar et al., 2005). (1+)

Ventilator-associated pneumonia would add burden on health care resources as it increases cost of hospitalization and morbidity of patients (Safdar et al., 2005). (1+)
Recommendation 2) Type of cleansing solution

2% chlorhexidine solution should be used for cleansing inside of mouth and decontamination to prevent ventilator-associated pneumonia. [A]

Evidence:

Using only 2% chlorhexidine solution was adequate to prevent ventilator-associated pneumonia in intubated patients (Tantipong et al., 2008). (1+)

Use of 2% chlorhexidine in oral care could successfully postpone ventilator-associated pneumonia development and decrease its daily risk by 65% in intubated patients (Koeman et al., 2006). (1++)

2% chlorhexidine diminished the risk of developing ventilator-associated pneumonia significantly. The lower the concentration of chlorhexidine, the lesser is its protective effect (Labeau, Van de Vyver, Brusselaers, Vogelaers, & Blot, 2011). (1++)
Rationale:

Using high concentration chlorhexidine as oral disinfectant was more effective than low concentration in intubated patients (Tantipong et al., 2008). (1+)

Chlorhexidine could decrease the aspiration of respiratory pathogens from oropharyngeal region into the lung by inhibiting the viability of oral pathogens (Ozçaka et al., 2012). (1++)

2% Chlorhexidine solution was able to tackle ventilator-associated pneumonia causing bacteria even these bacteria were resistant to many potent drugs (Scannapieco et al., 2009; Tantipong et al., 2008). (1+)

Chlorhexidine was desirable to use in preventing ventilator-associated pneumonia as it was a safe oral antiseptic, it had never induced drug resistance and it was economical (Koeman et al., 2006). (1++)
**Recommendation 3) Amount of solution used**

20 ml chlorhexidine solution should be used oral care of intubated patients. [A]

**Evidence:**

Daily risks of ventilator-associated pneumonia decreased 65% in treatment group by using 20 ml chlorhexidine for oral care (Koeman et al., 2006). (1++)

**Rationale:**

For the sake of patients’ best outcome, only the three rated as 1++ randomized controlled trial studies by The Scottish Intercollegiate Guidelines Network (2008) in the seven selected studies would be used in guideline formulation. In these three high quality studies, 20 ml chlorhexidine was used in the study of Koeman et al. (2006), while 30 ml chlorhexidine was used in studies of Scannapieco et al. (2009) and Ozçaka et al. (2012). Although these three studies were high quality randomized controlled trials with low risk of bias, 20 ml chlorhexidine would be chosen as Koeman et al. (2006) conducted the study in multicenter setting, and the sample size used was the largest among the three studies, this could greatly increase the generalizability of the study findings. Therefore, the amount of chlorhexidine in the oral care guideline would be 20 ml. (1++)
**Recommendation 4) Frequency of oral care**

Oral antiseptics should be used four times a day for oral decontamination. [A]

**Evidence:**

The incidence of ventilator-associated pneumonia in patients received oral care by chlorhexidine four times a day had been significantly decreased (Ozçaka et al., 2012). (1++)

There was 65% decrease in daily risk of ventilator-associated pneumonia incidence rate in patients who received chlorhexidine four times a day in oral care (Koeman et al., 2006). (1++)

**Rationale:**

Application of chlorhexidine four times daily was the major reason of the significant difference in ventilator-associated pneumonia incidence rate between study groups (Ozçaka et al., 2012). (1++)

The aim of the oral care guideline was to reduce the incidence rate of ventilator-associated pneumonia. In the three high quality studies previously mentioned, ventilator-associated pneumonia incidence rate conducted by Scannapieco et al. (2009) decreased by 40% (p=0.1459), it was not statistically
significant. However, the daily risk of ventilator-associated pneumonia has significantly reduced in the study of Koeman et al. (2006) (p=0.012); and the ventilator-associated pneumonia incidence rate in the study of Ozçaka et al. (2012) had also significantly decreased by 27.4% (p=0.03). In addition, ventilator-associated pneumonia rate was expected to be investigated as primary outcome. This could only be observed in the study of Koeman et al. (2006) and Ozçaka et al. (2012) among all, while these two studies used chlorhexidine in oral care four times a day. Therefore, the frequency of oral care in the guideline would be four times a day. (1++)
**Recommendation 5) Method of oral care**

The method used in oral care of intubated patients should be swabbing.  

[A]

**Evidence:**

No adverse effect was observed in patients using swabbing of chlorhexidine in oral care (Ozçaka et al., 2012; Scannapieco et al., 2009)  

(1++)

**Rationale:**

The major concern about method of oral care was about the presence of adverse outcome. Six of seven studies make use of swabbing as the method of application, and one of them uses rubbing. Swabbing did not have any adverse effect detected, but the use of rubbing induced 8.9% oral mucosa irritation (p=0.001) (Tantipong et al., 2008). Therefore, swabbing would be chosen.  

(1+)
Chapter 5: Implementation Plan

To ensure a successful implementation of the standardized and systematic oral care guideline, detailed implementation plan including communication plan, pilot study plan and evaluation plan should have been developed and evaluated prior full-scale implementation in the clinical settings. Gantt chart for oral care guideline implementation and evaluation plan had shown in Appendix 12.

A: Communication Plan:

Communication with stakeholders was crucial in introducing and actualizing the new oral care guideline. The plan for communication focused on methods and process of communication with stakeholders by using tactical communication methods, tools and techniques.

1. Stakeholders

Communication with stakeholders of different levels, including the administrative level, managerial level and frontline level, was important for dissemination of information, and to eliminate doubts of the guideline.

Administrative level

People involved at this level were department operating manager for nursing and the chief of service for doctors of the intensive care unit. They served as the gatekeepers
about introduction of different guidelines or any changes to intensive care unit. Gaining their approval was important as they hold the resources and authority of the department and had interest on the outcome benefit of any project.

**Managerial level**

People involved were ward managers, associate consultants, nursing specialists, advanced practice nurses and nursing officers. Ward managers had the authority to control staff logistics and liaise well between chief of service of doctors, department operating manager of nursing and frontline nurses. Associate consultants were able to communicate within medical doctors and gave advices throughout the implementation of the guideline. Nursing specialists, advanced practice nurses and nursing officers were clinical experts who always wanted to improve patient care outcomes. They could cooperate well throughout the implementation period using good problem-solving and decision-making skills.

**Frontline level**

People involved were nurses, house officers and medical officers. They served as the first line staff to actualize the oral care guideline when care patients. They were the main personnel who identify strength and weakness of the new oral care guideline.
2. Communication process

The first to communicate with were ward managers and associate consultants. In order to improve patient care outcome, both of them would be interested in reducing incidence of ventilator associated pneumonia (VAP) by implementing this oral care guideline. The significance, related evidence, feasibility and transferability, cost and benefits of this oral care guideline would be discussed. Upon gaining their approval, they would propose this guideline in details in service meeting to department operating manager and chief of service. After attaining their endorsement, the department would be financially and systemically supported to implement the new oral care guideline in clinical settings.

There is a need to form a communication committee to facilitate exchange of information between different parties (Details shown in Appendix 13).

3. Communication instruments (Details shown in Appendix 14)
4. Change process

Change process includes initiation, guidance and training were important components of sustaining the change.

To initiate the change, a seminar would be held to provide the latest evidence on VAP prevention showing the need of a new oral care guideline in intensive care unit (Details shown in Appendix 15).

To guide the change, a steering team would be formed to adopt “train the trainers” guidance approach and the steering team members would provide training sessions to all intensive care unit staff (Details shown in Appendix 16).

To sustain the change, the steering team would monitor the progress by observations at anytime and supervise staff for compliance (Details shown in Appendix 17).
B: Pilot study plan

Pilot study was a plan which aimed to test the efficacy, acceptability, feasibility and effectiveness of the innovation in local setting. Polit and Beck (2008) supported that pilot study tried to overcome practical difficulties of the innovation including patient recruitment, intervention used, data collection method and the evaluation plan of the innovation. The evaluation of the pilot study allowed revisions of the guideline and prevented unplanned obstacles before full implementation.

The four evaluative objectives of the pilot study were to evaluate the efficacy by assessing the training programs, to evaluate the feasibility and acceptability by nurse satisfaction level and material availability, to evaluate the effectiveness by comparing difference in VAP incidence rate; and to evaluate the need to revise the guideline.

Evaluation of efficacy of the training programs would be focused on the content and duration of training programs. Ten nurses from intensive care unit would be invited to participate in a one hour oral care training program spoken by nurse specialist, which included 30 minutes Power-point presentation, 20 minutes hands-on practice and 10 minutes return demonstration. The nurse specialist would present the Power-point and demonstrate on every step in providing oral care to intubated patients. Nurses had to return demonstrate on each step in order to unify the entire oral caring process. The participation level and the ability of nurses in return demonstration would be observed.
and documented throughout the training program to determine the efficacy of the training program. In order to have improvement of the training program, each nurse would be invited to fill in an evaluation questionnaire for training program (Appendix 18) and to attend a focus group, which helped to gain nurses’ opinions about the duration and content of the training program.

Feasibility and acceptability would be evaluated by assessing nurse satisfaction level and material availability. The pilot study would last for one month and would be guided by steering team. Thirty patients who meet the inclusion criteria would be recruited by convenience for the pilot study. The inclusion criteria of participants were patients receiving mechanical ventilator in intensive care unit and people who was 18 or above. The exclusion criteria of participants were patients who have pneumonia or VAP before admission to intensive care unit. Consent (Appendix 19) from eligible participants or participant’s relative would be obtained before the pilot study. The trained ten nurses would be responsible for carrying out the new oral care guideline on the recruited thirty participants for one month. Nurses had to fill up oral care and VAP checklist (Appendix 20) of each participant each time after oral care, so that four times a day. The ten nurses would be invited to share views or difficulties through questionnaires (Appendix 21) and focus groups in order to evaluate on the acceptability and feasibility of the oral care guideline. Questions concerning knowledge level, satisfaction level, and material availability would be focused in questionnaires and focus
groups.

To evaluate the effectiveness of the guideline, VAP incidence rate would be compared to that of last month. As the VAP incidence rate in the proposed ICU was prohibited, the VAP incidence rate one month before the pilot study would be traced back for comparison before and after the pilot study. According to American Thoracic Society (2005), pneumonia in people who was using mechanical support for respiration via endotracheal tube or tracheostomy within 48 hours before onset of infection is ventilator-associated pneumonia. Based on the definition of VAP, it was adequate to use one month time for detecting VAP. The effectiveness of the new oral care guideline on patient care outcome would be assessed by comparing VAP incidence rate in pilot study month with previous two months.

To evaluate the need to revise the guideline, nurses would be invited to fill up questionnaires related to the flow, content and satisfaction of the guideline and had discussions in focus groups. All the feedbacks collected in different questionnaires and focus groups would be gathered and carefully evaluated in order to revise the training program and the guideline before full implementation.
Chapter 6: Evaluation plan

Evaluation plan aimed to show the effectiveness of innovation in various aspects in local setting which also allowed easier detection of achievement of the innovation. Identification of outcomes to be achieved, process evaluation and outcome evaluation would be discussed.

Intervention outcomes to be achieved

Intervention outcomes could be classified into 1) patient outcomes, 2) health care professional outcomes, and 3) system outcomes. Patient outcomes were short term outcomes, while health care professional outcomes and system outcomes were long term outcomes.

1. Outcome measurement of short term outcome

a) Primary outcome: VAP incidence rate

The decrease in VAP incidence rate was the primary intervention outcome to be achieved. It could be updated by nurse everyday when completing oral care and VAP checklist from the day of intubation until diagnosis of VAP or extubation. VAP incidence rate would be reported as percentage.

b) Secondary outcome: Length of mechanical ventilation, ICU stay and mortality rate

Data about length of mechanical ventilation could be collected in the VAP checklist and it would be shown as days on mechanical ventilation. The other
secondary outcomes were intensive care unit stay and mortality rate. The number of days for intensive care unit stay and the percentage of mortality rate could be found in patient’s own hospital notes.

2. Outcome measurement of long term outcome

a) Health care professional outcome

It measured the satisfaction level of nurses, the acceptability of the guideline and the compliance of the guideline. The questionnaires completed and focus groups held after the training program and after the guideline implementation would contain the related information for evaluation. The information integrity of VAP checklist and oral care checklist would reflect the compliance of the guideline. Nurses would normally gain satisfaction by participating in this oral care guideline as there was potential improvement in patient care outcome.

b) System outcome

It would measure the balance between the costs of carrying out the guideline such as training cost, materials cost and staff cost, and the cost saved in reduction of VAP incidence rate and days in ICU stay. Balancing cost would be important for long-term accomplishment of the guideline.
Nature and number of clients involved

It was important to determine the number and characteristics of patients, methods to recruit participants and method to evaluate effectiveness before implementation in order to allow better planning for evaluation.

Eligibility criteria (Details shown in Appendix 22)

Sample size calculation

As the information about VAP incidence rate of the proposed hospital was extremely prohibited, the estimated VAP in ICU would be 9% to 67% (Centre for Health Protection of Department of Health of Hong Kong, 2010). As the discrepancy of VAP incidence rate would be too large, the middle number would be chosen so that 38% would be estimated to be used as the VAP incidence rate in the proposed hospital. The calculation of sample size would be dependent on the design and the primary outcome of the guideline. Pre-and-post design would be used, and the estimated VAP incidence rate of target setting was 38%. From the selected evidences, the VAP reduction rate ranged from 6.5% (Tantipong et al., 2008) to 65% (Ozçaka et al., 2012). To be more conservative, 6.5% would be adopted so that a larger sample size would be included. An online calculation tool would be employed to calculate the sample size (Lenth, 2006-2009). The statistical significance, alpha, was set at 0.05 and the power was set at
80%. Based on these assumptions, 146 patients would be needed to test for one proportion. For critical patients, 10% attrition rate was assumed, therefore the total number of patients to be recruited was 160.

Recruitment of samples (Details shown in Appendix 23)

Data collection and analysis

In order to ensure the validity and reliability of the self developed questionnaires, content validity index (CVI) and test-retest reliability would be used. Fifteen advanced practice nurse or nursing officers in ICU would be invited to rate the scale-level CVI and item-level CVI of the questionnaires. It was considered as valid if the scale level CVI was larger than 0.9 and that of item CVI was larger than 0.8 (Fayers, 2000). Moreover, one month interval would be offered for people who would participate in test-retest reliability test. It was considered as reliable if the calculated reliability coefficient was larger than 0.8.
Data collection

Steering team would collect data within the implementation period. Oral care and VAP checklist would be collected once in three days. Team nurse would need to complete the checklist every time after oral care. All data about primary and secondary outcome would be updated by patients’ hospital notes.

Steering team would retrieve participants’ data about length of ICU stay, length of mechanical ventilation, days of diagnosis of VAP and days of discharge from ICU in patients’ hospital notes; and fill up these information in the checklist. The checklist would be kept in patient’s hospital folder until hospital discharge. All the collected checklist or questionnaires would be analyzed at the end of each month. In order to collect data about nurse compliance, the integrity of oral care and VAP checklist would be checked on daily basis. Steering team would also observe nurses’ oral care compliance at anytime. Focus groups would be held after the implementation period, which would be audio-taped. Nurses would be invited to share their difficulties encountered or viewpoints throughout the guideline implementation period. Each group would have eight to ten staff and would be guided by one steering team member. Video tapes would be transcribed into verbatim so that meanings of different categories and themes would be presented in codes for evaluation.
Data analysis

Steering team would take the role in data analysis, which would include qualitative data and quantitative data. Qualitative data included different codes generated from focus group video tapes and quantitative data from questionnaires and checklists. Two-tailed z-test would be used to detect significance changes by using null hypothesis to analyze the VAP incidence rate. Null hypothesis of this project would be there was no difference in the VAP incidence rate before and after the implementation of the oral care guideline. The z-value would be ideally computed by Statistical Package for Social Sciences (SPSS), but SPSS did not have a direct z-test. Therefore, two tailed t-test would be employed with sample size larger than 30 for calculation in SPSS (Bruce & Patten, 2009). It would reject the null hypothesis if the z-value does not fall within the critical region, which was ± 1.96 if the level of significance was set at 0.05. This meant that alternative hypothesis would be accepted as the VAP incidence rate was different after the implementation of the oral care guideline.
**Criteria for effectiveness**

For success detection of this oral care guideline, the primary outcome should have been achieved. Moreover, process evaluation outcomes should have evaluated for guideline effectiveness before implementation in long-run.

The primary outcome for patient would be the VAP incidence rate. After calculation from the seven selected evidence, the VAP incidence rate would have an absolute decrease by 6.5%, so that the relative decrease in VAP incidence rate would be 2.5% in evaluating the achievement of the oral care guideline. In the target hospital, the estimated VAP incidence rate was 38%, therefore the oral care intervention was said to be effective if the VAP incidence reduced to 35.5%.

Healthcare professionals outcomes and system outcomes were the two most important process outcomes to be evaluated. For the healthcare professionals outcomes, the nurse’ knowledge level, compliance and acceptance of the guideline would be evaluated. The demonstration of nurses’ acceptance to the guideline could be shown by attaining at least 70 percent nurses indicating “agree” or “strongly agree” in the training questionnaires and the post-intervention questionnaires about gaining satisfaction from oral care training or oral care guideline with not less than 70 percent response rate. Moreover, the compliance of the guideline would be shown by at least 70 percent completeness of the oral care and VAP checklist, and the knowledge level of nurses would be demonstrated by 100 percent return demonstration of oral care training and not
less than 70 percent “agree” or “strongly agree” in questionnaires asking about nurses’ self evaluation of gaining skills. For the system outcomes, cost reduction, service quality and use of resources would be evaluated. The shorter ICU length of stay would cover the resources used to run the guideline and would demonstrate better quality of service.

**Conclusion**

Based on the transferability of the research findings, feasibility and cost-benefit ratio of the oral care guideline, the implementation potential of this new oral care guideline was high. The risk carrying out this oral care guideline to intubated patients was minimal, and the benefits of which had outweighed its risk. This oral care guideline on intubated patients was effective in reducing VAP, therefore reducing the cost of VAP, improving patients’ outcome and increasing working satisfaction of health care professionals. Moreover, the thorough communication plan with stakeholders and detailed evaluation plan of the application of this oral care guideline would gain success in the proposed hospital settings.
### Appendix 1:

Searching history on 31st August, 2012

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## Appendix 2: Table of evidence

<table>
<thead>
<tr>
<th>Bibliographic citations</th>
<th>Study type/evidence level</th>
<th>Setting</th>
<th>Patient characteristics</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Length of follow up</th>
<th>Outcome measures</th>
<th>Effect size</th>
<th>Source of funding</th>
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<tbody>
<tr>
<td>Grap et al., 2004</td>
<td>Randomized controlled trial, (II)¹</td>
<td>Medical and surgical ICU</td>
<td>Mean age was 50.3 (range 20-87), 71% was male, 29% female, enrolled within 12 hour of intubation, 50% were African Americans, 50% were Caucasians</td>
<td>Single application of 2 ml 0.12% CHX solution to cover all mouth surfaces by swab or spray (n=23)</td>
<td>Usual oral care (n=11)</td>
<td>Did not state</td>
<td><strong>Primary:</strong> &lt;br&gt; (1) Oral cultures with “no growth” at 48 hour (%) &lt;br&gt; <strong>Secondary:</strong> &lt;br&gt; (2) CPIS at 48 hour compared with CPIS at admission (experimental group) &lt;br&gt; (3) CPIS at 48 hour compared with CPIS at admission (control group)</td>
<td>(1) 21.7 (NS) &lt;br&gt; (2) 0.4 (NS) &lt;br&gt; (3) 1.9 (NS)</td>
<td>AD Williams Foundation of Virginia Commonwealth University</td>
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<tr>
<td>Koeman et al., 2006</td>
<td>Randomized controlled trial, (II)¹</td>
<td>Mixed and surgical ICUs in two university hospitals and three general hospitals</td>
<td>Mean age in Placebo group: 62.1 (SD +/−15.9), mean age in CHX group: 60.9 (+/−SD 15.3), 62% was male, 38% was female, all patients received mechanical ventilation for at least 48 hours and within 24 hour after intubation</td>
<td>Topical application of 2% CHX jelly four times a day to buccal cavity until diagnosis VAP, death, extubation, or withdrawal of consent (n=127)</td>
<td>Placebo (n=130)</td>
<td>25 months</td>
<td><strong>Primary:</strong> &lt;br&gt; (1) Daily risk of VAP (%) &lt;br&gt; <strong>Secondary:</strong> &lt;br&gt; (2) Relative risk of oral colonization with gram-positive micro-organisms &lt;br&gt; (3) Relative risk of oral colonization gram-negative micro-organisms</td>
<td>(1) 65 (HR=0.352; 95% CI; 0.160, 0.791; p=0.012) &lt;br&gt; (2) daily HR=0.695 (95% CI; 0.606, 0.796; P&lt;0.001) &lt;br&gt; (3) daily HR=0.826 (95% CI; 0.719, 0.950; P=0.007)</td>
<td>ZONMW, the Netherlands Organization for Health Research and Development</td>
</tr>
<tr>
<td>Bibliographic citations</td>
<td>Study type/ evidence level</td>
<td>Setting</td>
<td>Patient characteristics</td>
<td>Intervention</td>
<td>Comparison</td>
<td>Length of follow up</td>
<td>Outcome measures</td>
<td>Effect size</td>
<td>Source of funding</td>
</tr>
<tr>
<td>-------------------------</td>
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</tbody>
</table>
| Tantipong et al, 2008   | Randomized controlled trial, (II)<sup>1</sup> | ICUs and general medical wards | Mean age in Control group: 60.3 (+/- SD 19.1), mean age in CHX group: 56.5 (+/- SD 20.1), 49% was male, 51% was female, all patients received mechanical ventilation | Rubbing oropharyngeal mucosa with 15 ml of 2% CHX solution + brushing teeth + suctioning any oral secretions 4 times a day (n=102) | Rubbing oropharyngeal mucosa with normal saline solution + brushing teeth + suctioning any oral secretions 4 times a day (n=105) | 14 months | Primary: 
(1) Incidence of VAP (%) 
(2) Rate of VAP (episodes per 1000 ventilator-days) 
(3) Amount of new oropharyngeal colonization with gram-negative bacilli (%) 
Secondary: 
(4) Irritation of oral mucosa (%) 
(5) Overall mortality rate (%) | (1)-6.5 (RR 0.43=, 95%CI; 0.16,1.17,p=0.08) (2) -14 (p=0.04) (3)-43.9 (4)8.9 (p=0.001) (5)-2.9 (p=0.7) | Thailand Research Fund and Faculty of Medicine Siriraj Hospital |
| Munro et al., 2009      | Randomized controlled trial, (II)<sup>1</sup> | Medical-surgical ICU | Mean age: 47.9 (+/- SD 17.5), 60% male, 40% female, 59% non-white, 98% non-Hispanic, enrolled within 24 hours of intubation, Of 547 enrolled subjects, 249 subjects were still endotracheally incubated on Day 3, 158 subjects on Day 5, and 109 subjects on Day 7 | 5 ml CHX (0.12%) was applied by oral swab twice daily to evenly coat each tooth, the tongue, and the palate (n=57) | Usual oral care (n=64) | Did not state | Primary: 
(1) CPIS<sup>3</sup> on Day 3 (without pneumonia at baseline) 
(2) VAP on Day 3 (without pneumonia at baseline) (%) 
Secondary: 
(3) CPIS on Day 5 (without pneumonia at baseline) 
(4) VAP on Day 5 (without pneumonia at baseline) (%) 
(5) CPIS on Day 7 (without pneumonia at baseline) 
(6) VAP on Day 7 (without pneumonia at baseline) (%) | (1)-1 (p=0.02) (2)-28(p=0.006) (3)-0.01 (p=0.94) (4)-2 (p=0.84) (5)-0.44(p=0.59) (6) 20(p=0.52) | Grant from the National Institute of Health |
<table>
<thead>
<tr>
<th>Bibliographic citations</th>
<th>Study type/ evidence level</th>
<th>Setting</th>
<th>Patient characteristics</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Length of follow up</th>
<th>Outcome measures</th>
<th>Effect size</th>
<th>Source of funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scannapieco et al., 2009</td>
<td>Randomized controlled trial, (II)¹</td>
<td>Trauma ICU</td>
<td>Median age was 48 years (range 18.0 to 87.5 years), 70% was male, 30% was female; patients remain ventilated for at least 48 hours by consultation with attending doctors and nurses</td>
<td>Swabbing twice daily of all teeth, oral tissues, oral soft tissues, the floor of the mouth and tongue dorsum; one treatment arm once by 1 oz 0.12% CHX and once by placebo solution per day; the other treatment arm using 1 oz 0.12% CHX twice a day; plus routine oral care (n=58 in each group)</td>
<td>Swabbing twice daily of all teeth, oral tissues, oral soft tissues, the floor of the mouth and tongue dorsum using placebo solution; plus routine oral care (n=59)</td>
<td>39 months</td>
<td>Primary: (1) Number of Staphylococcus aureus on Day 2 in CHX once daily group (log of pathogen) (2) Number of Staphylococcus aureus on Day 2 in CHX twice daily group (log of pathogen) (3) Number of Staphylococcus aureus on Day 4 in CHX once daily group (log of pathogen) (4) Number of Staphylococcus aureus on Day 4 in CHX twice daily group (log of pathogen) Secondary: (5) VAP in CHX groups (%)</td>
<td>(1)-1.5(p=0.0065) (2)-2(p=0.0065) (3)-1.5 (p=0.0201) (4)-2 (p=0.0201) (5)-40 (OR= 0.54, 95% CI, 0.23 to 1.52, p=0.1459)</td>
<td>US Public Health grant from the National Institute of Dental and Craniofacial Research</td>
</tr>
<tr>
<td>Grap et al., 2011</td>
<td>Randomized controlled trial, (II)¹</td>
<td>ICU Trauma unit</td>
<td>Mean age: 42.4, +/- SD 18.2, 70% was male, 30% was female; enrolled within 12 hours of intubation, 75 of subjects remained endotracheally intubated at 48 hours; and that at 72 hours is 63</td>
<td>5 ml CHX (0.12%) was applied once to the oral cavity by swab covering all areas of the oral cavity, including the anterior and posterior pharynx, gums, teeth, tongue, and buccal mucosa; plus usual oral comfort care (n= 71)</td>
<td>Standard oral care that did not include CHX; plus usual oral comfort care (n= 24)</td>
<td>36 months</td>
<td>Primary: (1) CPIS at 48 hour compared with CPIS at admission (2) CPIS at 72 hour compared with CPIS at admission (3) Rate of subjects without VAP (CPIS &lt; 6) at baseline develop VAP in 48 or 72 hr (%) Secondary: (4) Length of stay (days) (5) Length of intubation (days)</td>
<td>(1)-1.35 (p=0.02) (2)-1.38 (p=0.027) (3)-22.3 (4)-2.3 (p=0.66) (5)-0.13 (p=0.94)</td>
<td>TriService Nursing Research Program</td>
</tr>
<tr>
<td>Bibliographic citations</td>
<td>Study type / evidence level</td>
<td>Setting</td>
<td>Patient characteristics</td>
<td>Intervention</td>
<td>Comparison</td>
<td>Length of follow up</td>
<td>Outcome measures</td>
<td>Effect size $^2$</td>
<td>Source of funding</td>
</tr>
<tr>
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<td>-----------------------------------------------------------------------------</td>
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</tbody>
</table>
| Ozçaka et al., 2012     | Randomized controlled trial, (II)$^1$ | Respiratory ICU | Mean age in CHX group: 60.5 (+/-14.7), mean age in control group: 56.0 (+/-18.2); mechanically ventilated for at least 48 hours | Swabbing the oral mucosa with about 30 mL of 0.2% CHX on sponge pellets four times a day last for 1 minute; plus positioning and deep suctioning very 6 hours (n=32) | Swabbing the oral mucosa with about 30 mL of normal saline on sponge pellets four times a day last for 1 minute; plus positioning and deep suctioning very 6 hours (n=29) | 24 months | Primary:  
(1) Incidence rate of VAP (%)  
(2) Mortality rate (%)  
Secondary:  
(3) Length of mechanical ventilation (days)  
(4) Length of stay in ICU (days)  
(5) Presence of potential respiratory pathogens in mini-BAL$^4$ | (1)$^{1-27.4}$ (p=0.03, OR =8.91, 95% CI, 1.09, 8.91))  
(2)$^{1-0.00754}$ (p>0.05)  
(3)$^{1(0.683)}$  
(4)$^{4-3.2}$ (p=0.279)  
(5) 64.7% of all isolated pathogen was Acinetobacter baumannii | Institutions of the authors |

1. Level of evidence defined by Melnyk & Fineout-Overholt, 2005  
2. Effect size = differences in means (intervention – control).  
3. Clinical Pulmonary Infection Score (CPIS<6: no VAP, CPIS>6=VAP) (Pugin et al., 1991)  
4. Mini-BAL= a technique that collect samples from the lung using a sterile suction catheter through the endotracheal tube to diagnose VAP (Kollef, Bock, Richards, & Hearn, 1995)  
CHX = chlorhexidine gluconate  
VAP = ventilator-associated pneumonia  
CI = Confident interval  
ICU = intensive care units  
HR = Hazard ratio=relative risk  
NS = not significant  
Cfu = Colony forming units
### Appendix 3: Quality assessment using SIGN

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The study addresses an appropriate and clearly focused question.</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
</tr>
<tr>
<td>2</td>
<td>The assignment of subjects to treatment groups is randomized</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
</tr>
<tr>
<td>3</td>
<td>An adequate concealment method is used</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Well covered</td>
</tr>
<tr>
<td>4</td>
<td>Subjects and investigators are kept ‘blind’ about treatment allocation</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Adequately addressed</td>
</tr>
<tr>
<td>5</td>
<td>The treatment and control groups are similar at the start of the trial</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Adequately addressed</td>
</tr>
<tr>
<td>6</td>
<td>The only difference between groups is the treatment under investigation</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
</tr>
<tr>
<td>7</td>
<td>All relevant outcomes are measured in a standard, valid and reliable way</td>
<td>Poorly addressed</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
<td>Well covered</td>
</tr>
<tr>
<td>8</td>
<td>What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?</td>
<td>At 48 hour, Experimental: 15%, Control: 8%</td>
<td>Experiment al: 56.5%, Control: 36.3%</td>
<td>On day 2, Experimental: 43%, Control: 50%</td>
<td>On day 3, Experimental: 52%, Control: 48%</td>
<td>On day 2, Experimental: 37%, Control: 68%</td>
<td>Overall 47%</td>
</tr>
<tr>
<td>9</td>
<td>All the subjects are analyzed in the groups to which they were randomly allocated (often referred to as intention to treat analysis)</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Where the study is carried out at more than one site, results are comparable for all sites</td>
<td>Adequately addressed</td>
<td>Well covered</td>
<td>Adequately addressed</td>
<td>Adequately addressed</td>
<td>Adequately addressed</td>
<td></td>
</tr>
</tbody>
</table>

**How well was the study done to minimize bias?**

- - ++ + + ++ + ++

**Level of evidence**

1- 1++ 1+ 1+ 1++ 1+ 1++

**Level of evidence**

1- 1++ 1+ 1+ 1++ 1+ 1++
### Appendix 4
Grading of recommendations/instructions scheme developed by the SIGN

#### Level of Evidence

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1++</td>
<td>High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias</td>
</tr>
<tr>
<td>1+</td>
<td>Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias</td>
</tr>
<tr>
<td>1-</td>
<td>Meta-analyses, systematic reviews, or RCTs with a high risk of bias</td>
</tr>
<tr>
<td>2++</td>
<td>High quality systematic reviews of case control or cohort studies, high quality case control or cohort studies with a very low risk of confounding or bias, and a high probability that the relationship is causal</td>
</tr>
<tr>
<td>2+</td>
<td>Well conducted case control or cohort studies with a low risk of confounding or bias, and a moderate probability that the relationship is causal</td>
</tr>
<tr>
<td>2 -</td>
<td>Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal</td>
</tr>
</tbody>
</table>

#### Grading of recommendation

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results</td>
</tr>
<tr>
<td>B</td>
<td>A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+</td>
</tr>
<tr>
<td>C</td>
<td>A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++</td>
</tr>
<tr>
<td>D</td>
<td>Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+</td>
</tr>
<tr>
<td>(GPP)*</td>
<td>Recommended best practice based on the clinical experience of the guideline development group.</td>
</tr>
</tbody>
</table>
Appendix 5:

Level of evidence of selected literatures:

<table>
<thead>
<tr>
<th>Study</th>
<th>Level of evidence using SIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grap et al. (2004)</td>
<td>1-</td>
</tr>
<tr>
<td>Koeman et al. (2006)</td>
<td>1++</td>
</tr>
<tr>
<td>Tantipong et al. (2008)</td>
<td>1+</td>
</tr>
<tr>
<td>Munro et al. (2009)</td>
<td>1+</td>
</tr>
<tr>
<td>Scannapieco et al. (2009)</td>
<td>1++</td>
</tr>
<tr>
<td>Grap et al. (2011)</td>
<td>1+</td>
</tr>
<tr>
<td>Ozçaka et al. (2012)</td>
<td>1++</td>
</tr>
</tbody>
</table>
Appendix 6:

Philosophy of care

In the proposed hospital, the philosophy of care is highlighted by the local hospital was that “we deliver quality health service to our clients” and “we promote learning culture, research and innovations”. Moreover, The Nursing Council of Hong Kong (2012) supported that “nurses should use scientific evidence in finding the best possible ways to provide nursing services for the well-being of patients/clients” and “nurses should value research and development for the promotion of nursing knowledge and skills”. It was anticipated that the proposed hospital would support the implementation of the innovation as the new oral care guideline that based on evidence of research in order to promote quality of health service and nursing skills.

Appendix 7:

Sufficient clients to benefit:

All patients in intensive care unit of the target hospital required mechanical ventilation. As stated in trauma statistics report of the target hospital, the number of trauma cases was 272 making up 39% of the total number of patients admitted to intensive care unit in 2010, therefore the total number of patients would be benefited was around 700 in each year.
Appendix 8:

Implementation and evaluation time:

The new oral care guideline would be implemented and evaluated in one year time. One month would be allocated for piloting the innovation in the proposed setting to allow modification to the guideline if required. Six months would be scheduled for further implementing and evaluating the guideline. Moreover, checklist concerning oral care and regular review by nurse leaders assigned would be evaluated and incidence of ventilator-associated pneumonia would be compared in evaluation.

Appendix 9:

Friction among staff:

As the new oral care guideline was similar to existing oral care practice in the target intensive care unit, potential friction among staff should be minimal. The implementation of new oral care guideline does not need extra manpower, although the workload would be slightly higher as the frequency of oral care would be increased from once daily to four times a day. Moreover, there might be some worries about the adverse effect of the new oral care guideline as the cleansing solution was different from what staff previously used. From the selected studies, it was noted that oral mucosa irritation was recorded in the study by Tantipong et al. (2008) as they used chlorhexidine to rub in the mouth of intubated patients, and tongue oedema
noted in the study of Koeman et al. (2006), however, the affected population was as low as 0.004 %. Otherwise, there were no other adverse outcomes noted. In the new oral care guideline, the method of application of chlorhexidine was swabbing instead of rubbing, therefore it was supposed to be safe when implementing the new oral care guideline.

Appendix 10:

Nurse training sessions

The training would be launched for one week and after the morning shift from Monday to Saturday held in treatment room of intensive care unit. Fifteen staff would be entertained in each training session. Six nurses would be trained as trainer in case of absence of staff in the training week. Trainers would be responsible for individual training of absent staff and monitor the implementation process during the implementation period.
Appendix 11:

Cost of implementing or not implementing the new oral care guideline

*Cost of implementing new oral care guideline*

Material cost:

0.5% chlorhexidine or thymol gargle solution would not be used. The new cleansing solution would be 2% chlorhexidine solution. It was $55 for one 500 ml bottle chlorhexidine (Hospital Authority, 2003), $8.8 was expected to be used on chlorhexidine for oral care of one patient each day. The estimated cost of 2% chlorhexidine solution for one patient was $3212 for one year. Moreover, there was an additional need to include mini-broncho-alveolar lavage (Mini-BAL) investigation in the diagnosis of ventilator-associated pneumonia (Ioanas, Ferrer, Angrill, Ferrer, & Torres, 2001). The suction catheter used to draw lung lavage in Mini-BAL test would be the same as usual.

Non-material cost

All nurses had to attend a one hour training session for unifying the procedures of oral care, and learning new method of collecting Mini-BAL samples. There were totally 85 nurses in the target intensive care unit and the average wage of nurses for one hour is about $200, the estimated cost of staff would be $17,000.
Mass email would be sent to all intensive care unit staff including physicians, nurses and administrators to invite for participating in this oral care guideline, gentle reminders would be additionally sent to physicians for writing diagnosis of ventilator-associated pneumonia into clinical notes of patients during the implementation period.

*Cost of not implementing the new oral care guideline*  

Cost would be mainly spent on days in intensive care units and extra antibiotic prescriptions. Extra and more potent antibiotics would be prescribed to tackle ventilator-associated pneumonia, and the additional length of stay in intensive care unit of patients acquiring ventilator-associated pneumonia was about five to seven days (Safdar, Dezfulian, et al., 2005). The cost of intensive care stay for one day was $13,900 (Hospital Authority, 2012). Therefore, the estimated cost of prolonged stay in intensive care unit would be ranged from $69,500 to $97,300 of each patient.
**Appendix 12:** Gantt Chart of implementation and evaluation of the oral care guideline

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication by communication committee with stakeholders to gain approval</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Training of steering team (train-the-trainer)</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Publicizing the guideline</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Carrying out pilot study and disseminate program results</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Revision to guideline, training, and operational facilities</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Training of ICU staff by steering team</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Implementation of oral care guideline</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Evaluation for health care professional outcomes</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Evaluation of patient outcomes</td>
<td>1st-12th</td>
</tr>
<tr>
<td>Evaluation of system outcome</td>
<td>1st-12th</td>
</tr>
</tbody>
</table>
Appendix 13: Communication committee

This committee would consist of seven members, who were two advanced practice nurse or nursing officers, three registered nurses with five years of working experience in intensive care units and with a master degree, one associate consultant and one pharmacist. The nurses of the communication committee were more skillful in complying and managing of the new guideline, and they were more familiar with the working environment of nurses and were able to supervise staff within the implementation period. The associate consultant would serve as the communication bridge between physicians, while the pharmacist communicates with pharmacy department.

The communication committee would send out mass internal emails to disseminate the new oral care guideline to all stakeholders. The committee would particularly invite all nurses and physicians of intensive care units to carry out the new oral care guideline. Hard copies of the guideline would also be given to ward manager to disseminate the guideline in usual ward meeting. Moreover, pharmacy department would be invited to supply 2% Chlorhexidine solution during the implementation period. The committee would also serve as a problem-solving team to answer questions raised up by the stakeholders. Changes would be made to the guideline according to stakeholders’ comments.
Appendix 14: Communication instruments

Series of communication instruments would be used to introduce the guideline, with the aim to arouse the attention and interest from stakeholders to implement the new guideline. Internal email would be sent to stakeholders to invite them to implement the oral care guideline in intensive care unit. PowerPoint slides would be employed in training sessions of frontline staff. Posters showing better patient outcomes by reducing VAP would be posted around the walls of intensive care unit. Moreover, emails would be sent to all intensive care unit physicians about the diagnostic criteria of VAP and kindly invite them to keep alert of VAP diagnosis during the pilot period. The latest oral care guideline implementation progress and success would be disseminated in ward meetings, notice boards and internal emails every two weeks, which aimed to increase staff’s morale of compliance to the new guideline. In order to be workable and user-friendly, guideline would be revised according to the comments collected in emails, questionnaires, ward meetings and informal focus groups throughout the implementation period. In addition, the communication committee would answer all the queries from frontline staff.
Appendix 15: Change initiation

A seminar would be held to provide the latest evidence on VAP prevention showing the need of a new oral care guideline in intensive care unit. The details of the guideline would be discussed, and the implementation of which would have prominent change on patient care outcomes especially VAP incidence rate. The introduction of new guideline would gain staff support by appreciating staff’s goal was to provide best patient care, though the new guideline would increase their workload. The seminar would be promoted by sending seminar poster and brief seminar information through email to all stakeholders. Posters and seminar information sheets would also be posted on information boards within the target hospital to arouse attention.
Appendix 16: Guidance of change

To guide the change, a steering team would be formed to adopt “train the trainers” guidance approach. The steering team served to train frontline staff to implement, to guide and to sustain the change. All members of the steering team would act as role models and problem-solvers throughout the implementation period. The steering team would comprise of members of communication team with the pharmacist substituted by nursing specialist. The nursing specialist would be invited to act as the representative and contact person of the steering team, who would deliver an one-hour training session to all steering team members about the details of providing new oral care to intubated patients. Return demonstration was needed for unification. After training up, steering team members would provide a total of six days one-hour training sessions to all intensive care unit staff in every afternoon of the training week held in treatment room, each training session would accommodate fifteen staff. The ward manager would arrange all 85 intensive care units staff to attend the training session. Trainers would be responsible for individual training of absent staff. Oral care reminder cards would be posted beside the computer of each patient bed for gentle reminder. Moreover, a checklist for oral care and ventilator-associated pneumonia in ICU (Appendix 2) would be attached to each patient’s file to remind and maintain the change. The checklist was served as a tool to verify the completion of the new oral care guideline and to monitor the incidence of VAP on patients.
**Appendix 17: Sustainment of change**

To sustain the change, the steering team would monitor the progress by observations at anytime and supervise staff for compliance. The checklists would be checked by steering team members for information integrity everyday. As mentioned, together with the updated implementation related statistics, the incidence of VAP would be monitored during the implementation period on weekly basis. These data would be disseminated in ward meetings, emails and notice board, which would increase staff compliance and morale in sustaining the guideline. Moreover, the steering team would answer all the queries and keep on receiving comments so as to modify the guideline within the implementation period.
Appendix 18: Evaluation Questionnaire for oral care training workshop

Part I: Please circle one standpoint that can mostly describe your feeling.

<table>
<thead>
<tr>
<th>1. Power-point teaching</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) The content is clear</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b) The content is relevant</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c) The content is easy to understand</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>d) The oral care skills demonstration is appropriate</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>e) Timing is acceptable</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Hands-on practice</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Instructions given are clear</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b) Explanation is clear</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c) Instructor is skillful</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>d) Instructor is reachable</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>e) Feeling good after the practice</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>f) Timing is acceptable</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Overall</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Time of this workshop is appropriate</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b) Venue of this workshop is appropriate</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c) The workshop content is relevant</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>d) The overall timing is acceptable</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Part II:
1. What are the parts that you think should have some improvement? Why?

2. What is the best thing about attending this training workshop? Please give reasons.

3. Can you give some comments about the training workshop?

Thank you for filling up this questionnaire!
Appendix 19: Consent form

Consent form about evidence-based oral care guideline in intubated patients

I _____________________________ (Name of participant/patient’s family member) hereby give the consent to participate in the research about evidence-based oral care guideline in intubated patients conducted by Chui On-lan, who is a master degree student of the University of Hong Kong, in the intensive care unit of Queen Elizabeth Hospital.

I understand that the information gained from me in this research may be published or utilized in future research. I /patient’s family member should have the right to privacy that my / my family member’s personal details should always be kept confidential and should not be retrieved by people other than the research team members.

The procedure has been thoroughly explained to me and I understand the potential benefits and risks. The participation in this research of me/my family member’s is totally voluntary.

I acknowledge that I/my family member have/has the right to ask any question throughout the research period and can withdraw at any time without any negative effects to my/my family member’s treatment, from the time-being to future.

_______________________________________
Name of participant/patient’s family member

_______________________________________
Signature of participant/patient’s family member

_______________________________________
Name of researcher

_______________________________________
Signature of researcher

_______________________________________
Date
Appendix 20:
Checklist for Oral care and Ventilator-associated pneumonia (VAP) in ICU

Date of Admission to ICU: ____________________
Date of Intubation in ICU: ________________ Bed number in ICU: ____________________
Date of Extubation in ICU: ________________ Date of VAP diagnosis:__________________

- Please “✓” the box if you have completed the procedure
- Please write “NA” for boxes that are not applicable to your case
- Please complete this checklist EVERY time after performing oral care (at about 7am, 1pm, 7pm & 1am) until the intubated patient discharge from ICU or diagnose VAP
- Please return checklist to steering team members if patient discharge from ICU or diagnose VAP

<table>
<thead>
<tr>
<th>Patient’s Oral Care Checkpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Date</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1. I have used 2% Chlorhexidine solution for oral care</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. I have used 20ml 2% Chlorhexidine solution for oral care</td>
</tr>
<tr>
<td>3. I have swabbed patients’ all mouth surfaces including anterior pharynx, posterior pharynx, gums, teeth, tongue, and buccal mucosa</td>
</tr>
<tr>
<td>4. I do not remove any usual oral care from patients (e.g. suctioning, head up)</td>
</tr>
</tbody>
</table>

Printed name
Signature
**Appendix 21**: Evaluation Questionnaire about perception of skills learned, knowledge level, and satisfaction level

Part I:
Please circle one standpoint that can mostly describe your feeling.

<table>
<thead>
<tr>
<th>1. Skills level</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I gained the skills needed for oral care guideline implementation</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b) I was able to swab all mouth surfaces when providing oral care to intubated patients</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c) I was confident to provide oral care using the new oral care guideline</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Knowledge level</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I understood the causative mechanism of VAP</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b) I knew the complications of VAP</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c) I was clear about the importance of oral care in VAP prevention</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>d) I understood the potential risk and benefit of the oral care guideline</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>e) The method to perform oral care was clear</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Satisfaction level</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) The content of the oral care guideline was clear</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b) The content of the oral care guideline had facilitate staff to implement</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c) The instructions given in guideline was clear</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>d) The materials needed in the guideline were readily available (e.g. 2% chlorhexidine solution)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>e) I was able to handle well with the workload of the guideline</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>f) I was able to meet all the requirement needed by the guideline</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
Part II:

1. What is the most difficult thing you have met throughout the guideline implementation? Please give reasons.

2. What is the best thing you have gained throughout the guideline implementation? Please give reasons.

3. What are the parts you think should have some improvements? Why?

Thank you for filling up this questionnaire!
Appendix 22: Eligibility criteria

Homogeneity could be kept by using same nature of participants of the selected best available evidences in forming the oral care guideline. The target patient population would be patients aged 18 or above and who were mechanically intubated in ICU. The exclusion criteria were patients who have pneumonia at enrollment or having intubation within 48 hours before enrollment.

Appendix 23: Recruitment of samples

Convenience sampling would be used to recruit participants in ICU. There were approximately 58 patients admitted to ICU each month with about 90% of them were intubated. Approximately three months would be needed to recruit 160 patients.
References:


